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Gaskell

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[54] **LIQUID CIRCULATING SYSTEM FOR PHOTOGRAPHIC FILM PROCESSING TANKS**

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[73] Assignee: **Pako Corporation,** Minneapolis, Minn.

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[52] **U.S. Cl.** **354/321;** 354/324; 134/122

[51] **Int. Cl.²** **G03D 3/06**

[58] **Field of Search** ..... 95/89 R, 94 R; 134/122; 118/405, 419; 354/321, 324, 328

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Primary Examiner—Fred L. Braun

Attorney, Agent, or Firm—John W. Adams

[57] **ABSTRACT**

This is a liquid circulating system for film processing tanks and includes a submerged solution intake manifold located within the tank and particularly constructed with inlet openings and flow control elements to cause uniformly concentrated processing solution to travel along the film path in contact with the film surface to be processed, said inlet openings also being located in predetermined spaced apart relation along the film path to draw off the processing solution immediately after its chemical reaction with the film strip being transported through the film processing tank, thus minimizing the dispersion of the products of the chemical reaction into the main body of processing liquid, the circulating system may also include means for replenishing the processing chemical solution withdrawn through the intake manifold and thereafter recirculating the replenished solution back into the processing tank.

8 Claims, 5 Drawing Figures

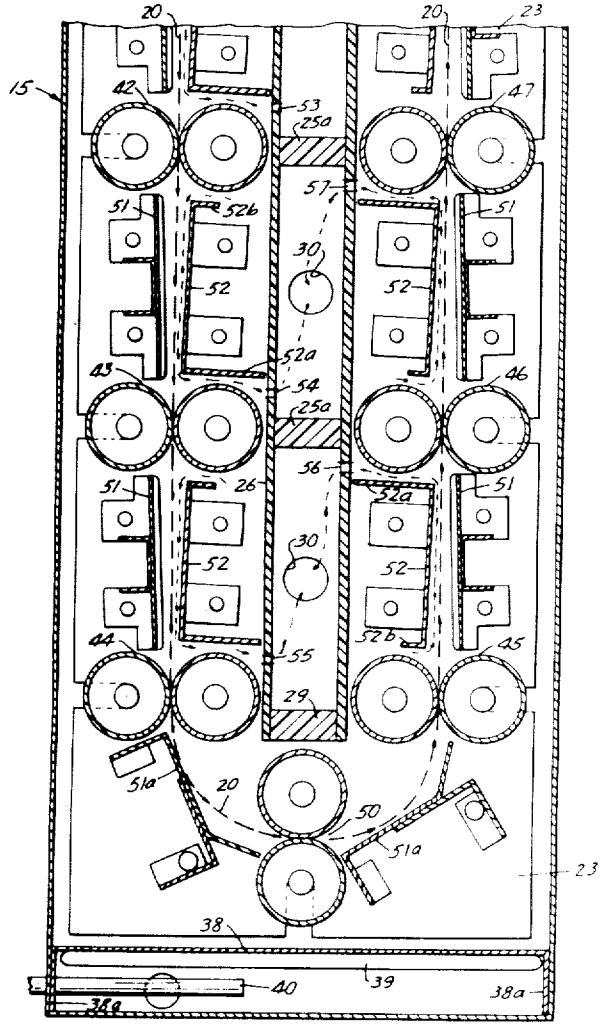


FIG. 3

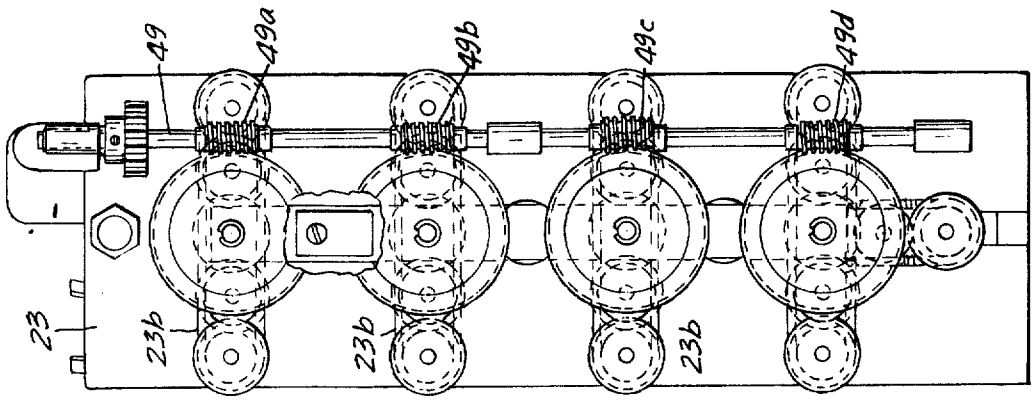


FIG. 2

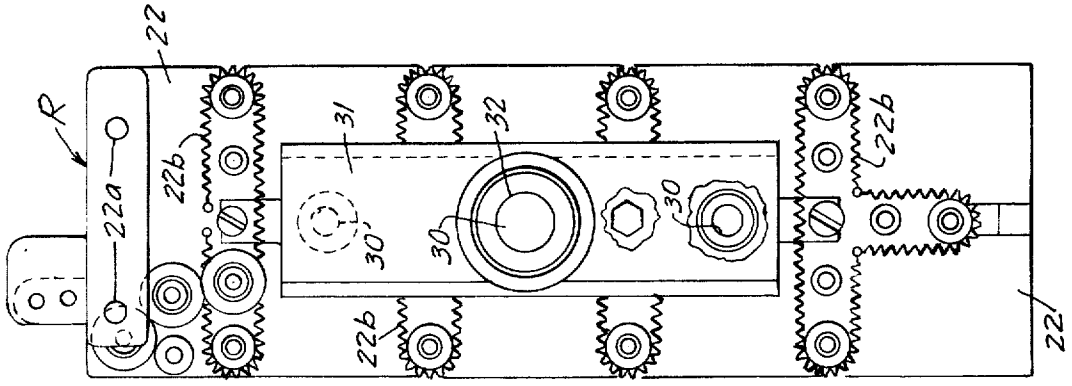
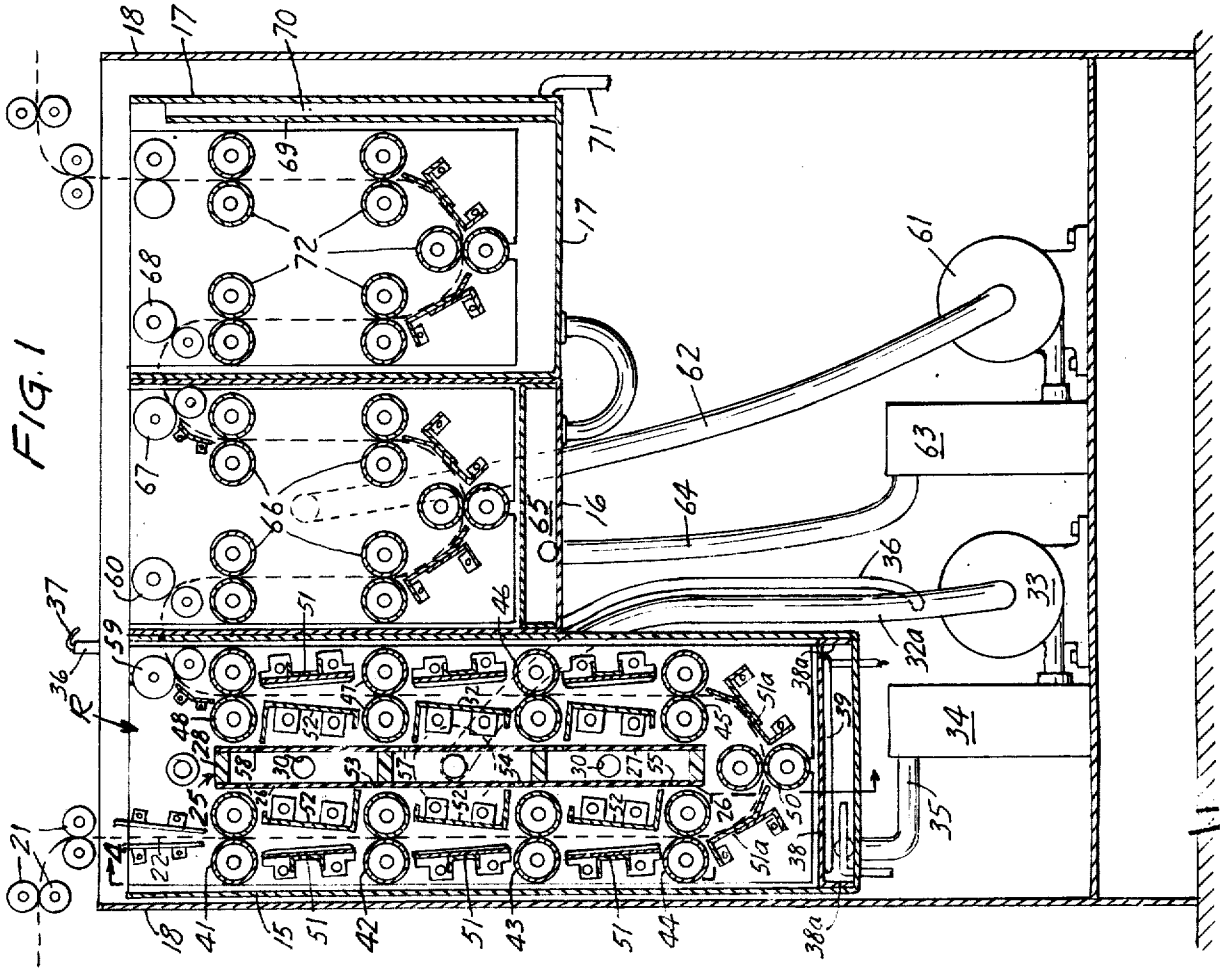


FIG. 1



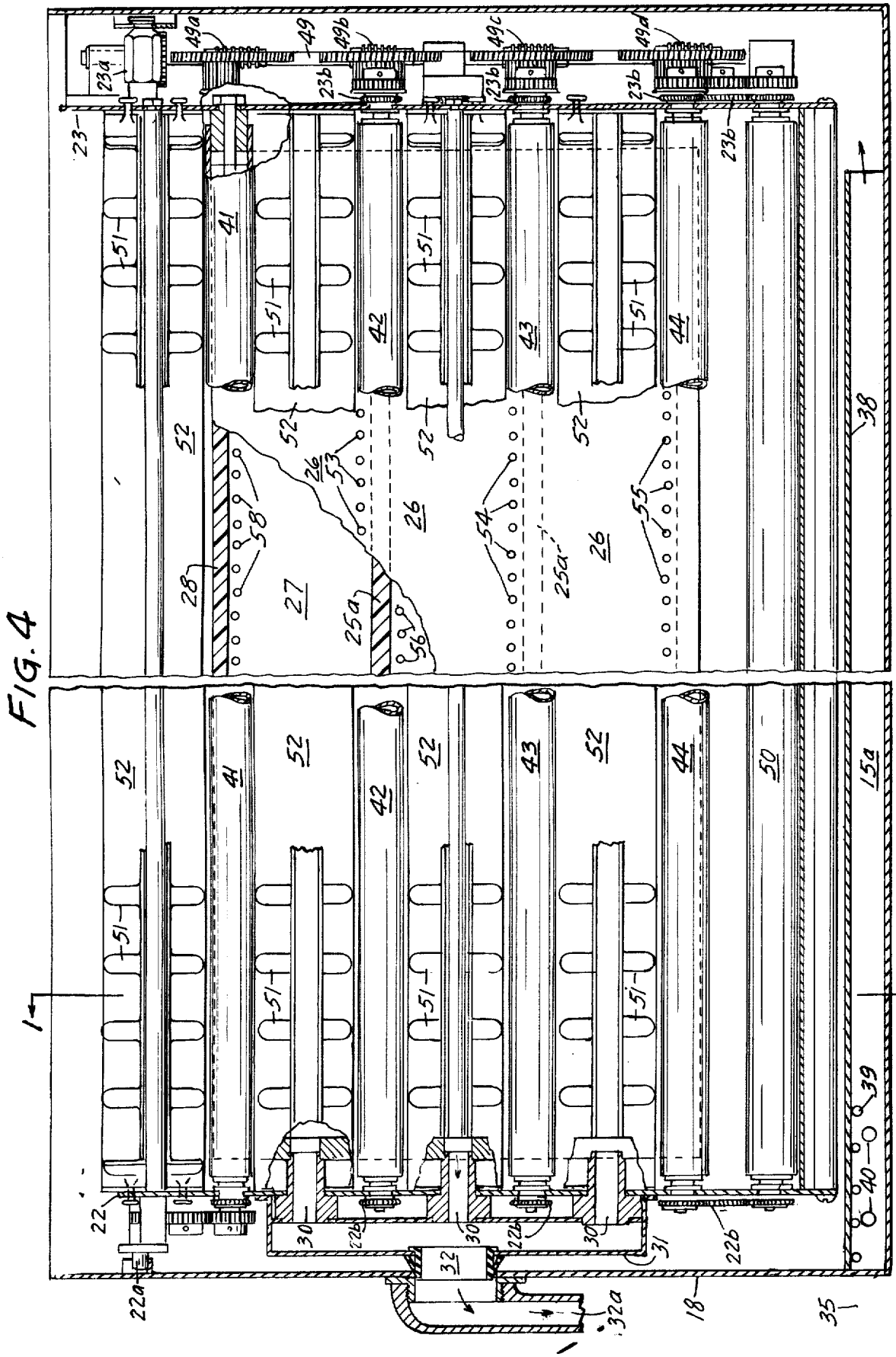

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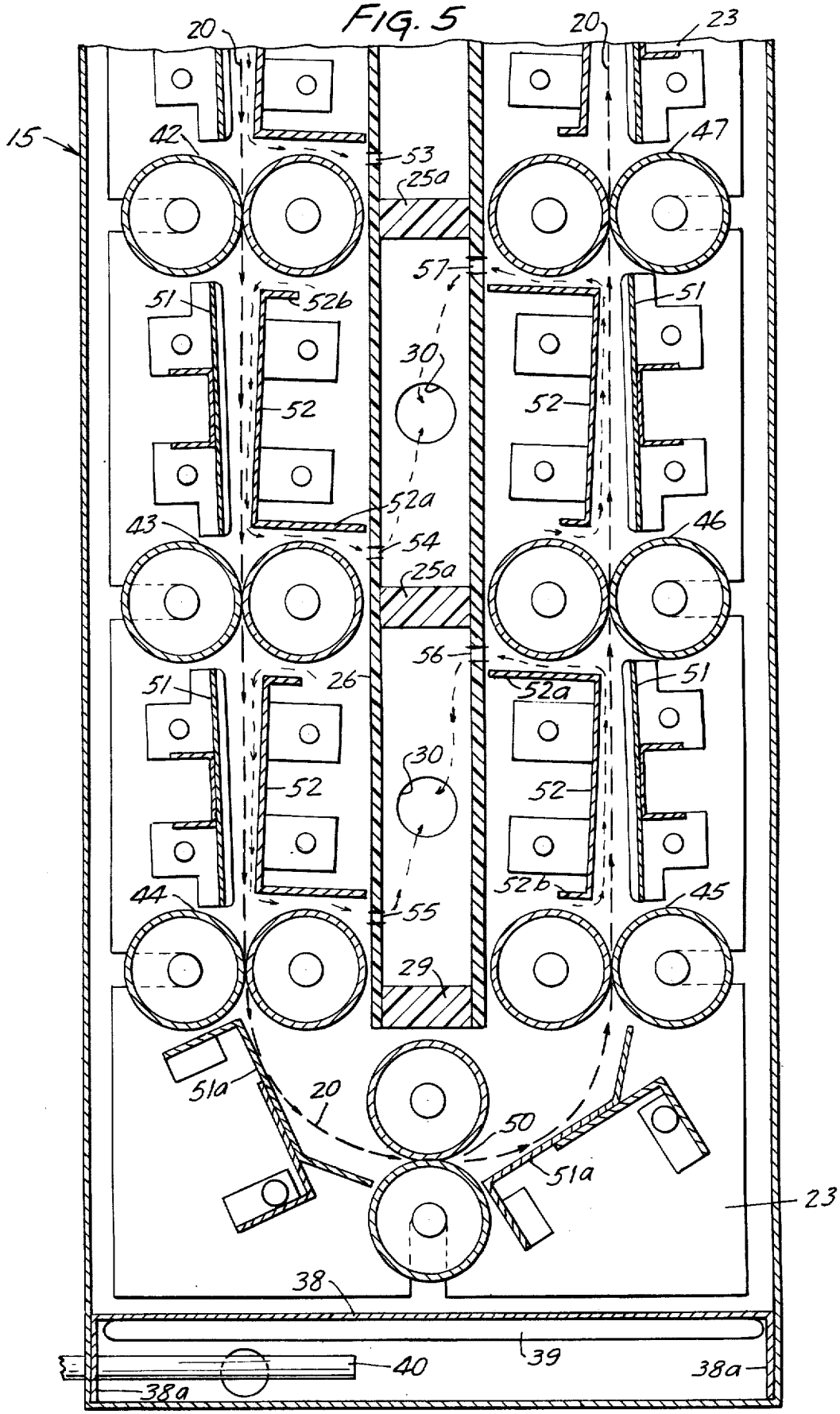
FIG. 4

FIG. 5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LIQUID CIRCULATING SYSTEM FOR PHOTOGRAPHIC FILM PROCESSING TANKS

It has always been a problem in the processing of photographic film to provide fresh uniformly active processing liquid to produce a uniform substantially constant chemical reaction with the surface of the film to be processed. Previously this has been accomplished by introducing fresh liquid under positive pressure adjacent the transfer rollers. That system however localizes the fresh liquid and produces substantial variations in the chemical concentration at various areas of contact with the film surface during the film processing operation and maintains all of the by-products of the chemical reaction in the main body of the solution in the tank.

The present system is specifically designed to draw off the liquid immediately after its chemical reacting contact with the film surface to minimize intermixing of the by-products of the chemical reaction with the main body of the processing liquid and to permit replenishment of the chemical reactivity of the withdrawn liquid before reintroduction back into the main body of liquid, the location of the inlet openings for drawing off the contaminated liquid combining with a baffle arrangement to cause fresh processing liquid from the main body of liquid in the tank to be circulated along the path of travel of the film through the tank and at substantially the same speed and in the same direction as said travel path to produce a minimum of turbulence and agitation of the liquid when in contact with the surface of the film being processed.

It is an object of the present invention to provide a circulation system for film processing liquid specifically designed to maintain substantially uniform chemical strength throughout the entire processing tank and to insure uniform non-turbulent contact of fresh processing liquid with the film surface being processed.

It is another object to provide a liquid circulation system particularly adapted for use with film developing tanks and, which is specifically designed to draw off the developer solution immediately after its chemical reaction with the film surface being processed to minimize intermixing of the reaction by-products and thereafter the chemical concentration of the liquid may be replenished before the same is recirculated back into the main body of processing liquid in the tank.

It is still a further object of this invention to provide a circulating system including a number of baffles disposed in substantially parallel relation to the path of travel of the film being processed, to cause the processing liquid to travel in a flow path along the film path, in the same direction and at substantially the same speed as the film and further to withdraw the liquid immediately after its processing contact with the film surface.

These and other objects and advantages of this invention will more fully appear in the following description made in connection with the accompanying drawings, in which like reference characters refer to similar parts throughout the several views, and, in which:

FIG. **1** is a central transverse sectional through a processing tank and solution circulating system embodying this invention;

FIG. **2** is an end elevational view of one end of the film transport rack provided in the processing tank;

FIG. **3** is a view of the other end of said rack;

FIG. **4** is a longitudinal sectional view taken through the developer tank with the rack assembled therein and with portions of the rack broken away; and,

FIG. **5** is a fragmentary transverse sectional view showing a portion of the circulation system embodied in the developer tank.

The photographic film developing apparatus illustrated in the accompanying drawings includes three separate tanks **15, 16** and **17** all mounted within a housing **18.** The tank **15** contains the developer chemical liquid. The tank **16** contains the fix liquid and the tank **17** contains the wash water liquid. The film strip is designated by the numeral **20** as indicated by the dotted lines of FIGS. **1** and **5** and is introduced into the top of the tank **15** through the two sets of power driven feed rollers **21** best shown in FIG. **1.** The developer tank **15** contains a removable roller rack unit designated as entirety by the letter "R."

The developer rack R includes a pair of end plates **22** and **23** with a centrally disposed intake manifold **25** extending therebetween. The intake manifold includes a pair of spaced apart side panels **26** and **27** and a pair of top and bottom closure members **28** and **29.**

In the form shown the manifold is divided into a plurality of compartments as by the spacer and divider elements **25***a* and suction outlets are respectively formed at one end of each compartment as by the verically spaced conduits **30** best shown in FIG. **4.** A secondary suction manifold **31** receives the liquid delivered through the outlets **30** and this liquid is withdrawn through a main outlet opening **32** which is connected to the intake of a circulation pump **33** which in turn delivers the liquid back into the bottom of the tank **15** through a filter **34** and a conduit **35.** A suction conduit **32***a* extends from the outlet opening **32** to the intake of the pump **33** and replenisher fluid is fed into the suction line **32***a* by any suitable means such as the stand pipe **36** which receives replenisher fluid through a supply tube **37.** An inlet distribution chamber **15***a* is formed in the bottom of the tank **15** by a horizontal separating baffle plate **38** spaced above the bottom of the tank **15** as by the depending flange elements **38***a* best shown in FIGS. **1** and **5.** Suitable means for controlling the temperature of the fluid in the tank are located in the inlet distribution chamber **15***a* such as the cooling coil **39** and the electric heating probes **40** which are thermostatically controlled in a conventional manner (not shown).

The film **20** is transported through the tank by a plurality of pairs or sets of power driven transporting rollers. The intake manifold **25** extends longitudinally through the central portion of the tank and four sets of such rollers respectively designed by the numerals **41, 42, 43** and **44** are provided on the film entrance side of said manifold and four sets **45–48** are provided on the film exit side thereof. These sets of rollers are vertically spaced apart to provide three separate zones on each side of the manifold **25** along the film path through the tank **15.** The rollers **41–44** on the entrance side are driven in a direction to transport the film downwardly from the lead-in rollers **21** and the rollers **45–48** are driven in a direction to transport the film upwardly on the exit side of the intake manifold **25.** Suitable drive train assemblies are driven by a drive shaft **49** with worm gears **49***a*, **49***b*, **49***c* and **49***d*. The gear wheels of the drive train provide driving rotation to all of the rollers **41–48** as well as an additional set of rollers **50** which is provided at the bottom of the rack R to assist

the film during its travel across from the entrance side of the partitioning manifold to the exit side thereof. FIGS. 2, 3 and 4 show a plurality spring elements 22*b* and 23*b* at the ends of the outer roller of each set for maintaining resilient pressure between each pair of rollers and provide a squeegee action on the film as it passes through each set of rollers.

Suitable film guides 51 are provided between consecutive sets of rollers 41 through 48 and additional guides 51*a* are provided at the bottom of the rack R.

A plurality of flow control baffle members 52 are mounted in opposed spaced relation from the guides 51 and extend across between consecutive sets of rollers as illustrated and each baffle has a flange 52*a* along the downstream edge thereof in spaced relation to the adjacent set of rollers and a flange 52*b* along the upstream edge thereof. The space between consecutive sets of rollers and defined between the respective baffle plates 52 and the film path will be identified herein as flow control zones. Rows of openings such as apertures are provided in the side panels 26 and 27 respectively and are located along the downstream edge of each flow control zone. The row of such apertures at the lower end of the zone between rollers 41 and 42 is designated by the numeral 53, the row of apertures between rollers 42 and 43 by the numeral 54 and row of apertures between rollers 43 and 44 by the numeral 55. On the entrance side of the partitioning manifold 25 these apertures are disposed at the bottom of the respective zones which is the downstream edge with respect to the direction of travel of the film 20. Rows of apertures 56, 57 and 58 are provided in the side panel 27 at the upper ends of each zone which is also the downstream edge of each zone with respect to the direction of travel of the film 20 which is moving upwardly on the exit side of the manifold.

The entire rack assembly R is shown in FIG. 4 in assembled position within the tank 15. The rack is removably supported by a pair of spaced apart support pins 22*a* fixed in outstanding relation to the end plate 22. The support pins 22*a* are received in suitable cradles 15*b* fixed to the end wall of the tank 15. The other end of the rack is supported by a grooved supporting lug 23*a* fixed to end plate 23 and received in a U-shaped notch formed in a bracket 15*c* fixed to the other end plate of the tank 15. The position of the spaced pins 22*a* and of the lug 23*a* with respect to the cradles 15*b* and notched bracket 15*c*, position the outlet 32 in registration with the discharge opening provided in the end wall of the tank 15 as best shown in FIG. 4. The opening 32 has a tapered gasket member 32*b* surrounding the same and the tapered portion is received in sealed relation within the opening formed in the end wall of the tank 15 to which the suction conduit 32*a* is connected. Since the suction conduit 32*a* is under negative pressure the seal between the gasket 32*b* and the tank is not extremely critical.

Suitable cross-over rollers 59 at the top of tank 15 carry the film out of the tank and rollers 60 at the top of tank 16 receive the film strip and direct it downwardly into the fix solution in tank 16. The transport system and circulating system in the fix tank are of conventional design wherein the fix solution is circulated by a pump 61 which receives the solution from the top of the tank through an intake conduit 62 and discharges back into the tank through a filter 63 and a conduit 64. A temperature control chamber 65 is provided below the bottom of the tank 16 which bottom serves as a heat exchange panel when water at a controlled temperature is circulated through the chamber to maintain the fix solution at the desired temperature. Suitable sets of transport rollers 66 carry the film through the fix tank and cross-over rollers 67 transport the film out of the fix tank and into the wash tank 17 where a pair of rollers 68 direct the film downwardly into the wash tank. The water from the temperature control chamber 65 is discharged therefrom into the bottom of the wash tank and a suitable level control partition 69 serves as a weir to maintain the wash water at the desired level and permits the discharge thereof through a discharge chamber 70 and a discharge pipe 71. Suitable sets of rollers 72 transport the film strip through the wash tank 17. When the film leaves the wash tank 17 it is transported by suitable rollers to a dryer (not shown) and final processing.

OPERATION OF THE DEVELOPER CIRCULATION SYSTEM

The pump 33 withdraws liquid into the chambers of the intake manifold 25 through the rows of apertures 53 through 58 and out through the outlet tubes 30, secondary manifold 31 and main outlet opening 32. The replenisher fluid is supplied at the intake of the pump 33, is thoroughly mixed with the solution being drawn from the developer tank by the pump impellers and the replenished solution is discharged through the filter 34 and conduit 35 back into the tank below the horizontal baffle member 38. The rows of intake openings combine with the rollers and baffle members to withdraw the liquid immediately after its contact with the film surface being developed thus minimizing the dispersion of the reaction by-products into the main body of the developer fluid and also preventing accumulation of these byproducts on the surface of the rollers. The volume of liquid handled by the pump is such that the rate of travel of the liquid along its flow path in contact with the film surface is substantially the same as the linear rate of travel of the film, thus minimizing the turbulence of the liquid while in contact with the film strip.

It will be seen that I have provided a liquid replenishing and circulating system particularly adapted for use with film processing tanks which is particularly designed to produce a liquid flow path in contact with the film surface which will result in a minimum of turbulence during such contact and which is specifically constructed to remove the by-products of the chemical reaction with the film strip surface after limited contact therewith to minimize dispersion of said by-products into the main body of the processing liquid and maintain uniform fresh liquid in contact with the surface of the film being developed.

It will, of course, be understood that various changes may be made in the form, details, arrangement and proportions of the parts without departing from the scope of this invention as set forth in the appended claims.

What is claimed is:

1. In a photographic film processing tank with processing liquid therein and including means for transporting a web of film in a guided film path through said tank;

a system for circulating portions of the film processing liquid in a predetermined flow path within the tank, said system comprising

an intake manifold located within the tank and having the major portion thereof disposed below the surface of the processing liquid in the tank and in-

cluding

side wall portions having a plurality of intake openings disposed in close association to the film path on the emulsion side thereof,

liquid flow control means within the tank and disposed outside of said manifold and defining a liquid flow path generally parallel to and adjacent said film path

the position of the intake openings being such that the liquid is drawn through said openings at the downstream end of its flow path to cause the liquid to flow through said flow path in the same direction of travel as said film,

means for producing negative pressure in the manifold to withdraw liquid from the tank into the manifold through said openings, and

means for intorducing the withdrawn liquid back into the processing tank at a location remote from said flow path.

2. The structure set forth in claim **1** wherein said flow control means defines a flow path divided into a plurality of vertically spaced flow control zones and wherein said intake openings are desposed in a row at the downstream edge of each zone to limit the contact time between the specific portion of the processing liquid in contact with the film to each zone and withdraw said specific liquid along the downstream edge of each zone through said rows of intake openings.

3. The structure set forth in claim **2** wherein said liquid control means include a plurality of baffle members respectively provided in each zone along the guided film path in closely spaced relation thereto with the rows of intake openings being disposed along the downstream edge of the respective baffle members.

4. The structure set forth in claim **1** wherein said intake manifold is removably mounted in said tank and is provided with an outlet opening having a readily removable seal connection with the suction side of the introducing means.

5. The structure set forth in claim **2** and a plurality of vertically spaced power driven sets of film transport rollers defining the guided film path through the tank and also defining the upper and lower edges of the respective flow control zones,

each set of rollers consisting in a pair of opposed roller elements having resilient tangential surface contact therebetween to engage with a squeegee effect both sides of a strip of film being fed therethrough to impart driving motion thereto and to squeegee off the by-products of the chemical reaction between the solution and the film surface being processed,

the position of the intake openings being in close proximity to the respective sets of rollers located at the downstream edge of each zone to draw off the concentration of said reaction by-products and prevent dispersion of said concentrated by-products into the portion of the solution in contact with the film surface.

6. The structure set forth in claim **1** wherein the means for producing negative manifold pressure produces a similar rate of travel between the liquid in the flow path and the film strip.

7. The structure set forth in claim **1** and means for replenishing the chemical concentration of the processing liquid.

8. The structure set forth in claim **7** and said replenishing means including means for injecting replenishing chemical into the solution flow line between the intake openings and the introducing means.

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